

IN THE SPECIFICATION

Please delete paragraphs 20 – 34 and insert the following therefor:

[0020]

In order to achieve the purpose as stated above, a first invention provides a semiconductor single crystal manufacturing apparatus using the Czochralski method comprising a crucible for pooling melt of a raw material of a semiconductor single crystal, and a plurality of heaters vertically disposed outside the crucible for heating and melting the raw material, wherein a heat shield is provided in a space between the crucible and a substance which is disposed outside the plurality of heaters, the substance facing the plurality of heaters, or in the vicinity of that space, each of the heaters is independently supplied with electric power, and the heat shield is provided in a location in the vicinity of an area where an amount of generated heat is relatively low among generated heat distribution by all of the heaters.

[0021]

A second invention provides the first invention, wherein the area where an amount of generated heat is low is provided by, for a heater located on an upper side, adjusting a resistance value for heater respective portions such that the amount of generated heat in a heater lower portion is lower than that in a heater upper portion, and for a heater located on a lower side, adjusting the resistance value for the heater respective portions such that the amount of generated heat in a heater upper portion is lower than that in a heater lower portion.

[0022]

A third invention provides the first invention, wherein the substance which is disposed outside the plurality of heaters, facing the plurality of heaters, is a heat insulating material.

[0023]

A fourth invention provides the second invention, wherein the substance which is disposed outside the plurality of heaters, facing the plurality of heaters, is a heat insulating material.

[0024]

A fifth invention provides the first invention, wherein the heat shield is provided around the entire periphery of the crucible.

[0025]

A sixth invention provides the second invention, wherein the heat shield is provided around the entire periphery of the crucible.

[0026]

A seventh invention provides the invention 1 to the invention 6, wherein the material constituting the heat shield contains a graphite fiber material or graphite.

[0027]

An eighth invention provides the first invention or the second invention, wherein an inside diameter of the heat shield is larger than an outside diameter of the plurality of heaters.

A ninth invention provides a graphite crucible, wherein the application therefor is the semiconductor single crystal manufacturing apparatus of claim 1 in which a heat shield is provided outside the crucible.

Effects of the Invention

[0028]

According to the first invention, a heat shield is provided in the space between a substance which is disposed outside the plurality of heaters, facing the plurality of heaters, and the crucible, or in the vicinity of that space, thus the directionality (directivity) of the heat radiated from the heater can be enhanced, and the heating region for the heater can be localized. In addition, the respective heaters are independently supplied with electric power, and the heat shield is provided in a location in the vicinity of the area where the amount of generated heat is relatively low among the generated heat distribution by all the heaters, thus the directivity of heat radiation in a prescribed region for the heater can be enhanced. Whereby, the temperature distribution in the crucible and the melt in the crucible (the "temperature distribution in crucible" can be actively provided.

[0029]

According to the second invention, in addition to the effects of the first invention, as shown in Fig. 10, the heat shield is provided substantially in the central portion in the vicinity of the heater outside periphery in the intermediate area where the amount of generated heat in the heater is relatively low, thus the upper area of the crucible can be heated to a high temperature by the side upper-stage heater, while the lower area of the crucible can be heated to a high temperature by the side lower-stage heater, and the heat shield is provided, whereby the directivity of the heat radiation for the side upper- and lower-stage heaters can be enhanced, thus the temperature distribution in crucible can be actively provided.

[0030]

According to the third invention and the fourth invention, the substance which is disposed outside the plurality of heaters, facing the plurality of heaters, is a heat insulating material, thus the heat radiated from the heater can be effectively insulated.

[0031]

According to the fifth invention and the sixth invention, in Fig. 1, for example, heat shields 20, 21 are provided around the entire periphery of the crucible 3, thus the heat shield effect can be sufficiently exerted.

[0032]

According to the seventh invention, the material used for the heat shield has high thermal insulation properties, and is thermally stable, thus the mutual thermal interference between adjacent heaters can be effectively suppressed, and the contamination of the single crystal can be avoided.

[0033]

According to the eighth invention, the inside periphery diameter of the heat shield is larger than the outside diameter of the plurality of heaters, thus, in Fig. 4, for example, the heat shields 22, 23 can be easily mounted to and removed from the inside of the chamber 2, and further the possibility that the heat shield is contacted with the heater having a high voltage to be energized thereby, or an abnormal discharge is caused across both can be eliminated.

[0034]

According to the ninth invention, the application for the graphite crucible is the semiconductor single crystal manufacturing apparatus of the first invention in which a heat shield is provided outside the graphite crucible, thus the temperature distribution in crucible for the graphite crucible can be effectively controlled.